Model Answer: Winter-2019

Subject: Irrigation Engineering

Important Instructions to Examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	**a)**	**Attempt any <u>THREE</u> of the following:**		**12**
	(i) **Ans.**	**Define 1. Runoff 2. Irrigation 3. Maximum flood discharge 4. Hydrological cycle** **(1) Runoff:** The amount of water which flows over the surface of earth after all losses have taken place is called as runoff. **OR** The part of rainfall which flows over the surface of water after all losses have taken place is called as runoff **(2) Irrigation:** The process of artificially supplying water to soil for raising the crops is called as irrigation. **OR** 'This artificial application of water to the land in accordance with the crop requirement is called as Irrigation.' **(3) Maximum flood discharge:** Maximum flood discharge is maximum concentration of flow from a catchment area at the outlet in a small period. . **(4) Hydrological cycle:** It is the cycle which deals with science of occurrence distribution and circulation of water on earth on and below the earth surface.	**1 each**	**4**
	(ii) **Ans.**	**Classify the irrigation project on the basis of purpose and administration.** **a) Classification based on purpose:** 1) Single purpose irrigation project: This type of project mainly constructed and founded under one head or purpose like irrigation, power generation etc.	**1**	
		2) Multipurpose irrigation Project: It is a project which is constructed for two or more purpose such as irrigation, power generation etc.	**1**	

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	**(ii)**	**b) Classification based on Administration:**		
			2	**4**
	(iii)	**Compute the MFD of the stream over a catchment area of 150 Km^2 using :** **(1) Dicken's formula (C=27)** **(2) Ingli's formula**		
	Ans.	Given, A = 150 Km^2 , C = 27 **(1) Dicken's formula** Q = C A$^{3/4}$ Q = 27 X 150$^{3/4}$ Q = 27 X 42.86 Q = 1157.22 m^3/sec	**2**	
		(2) Ingli's formula Q = 123A/ √ (A+10.24) Q = 123 x 150 / √ (150+10.24) Q = 18450/ √ 160.24 Q = 18450 / 12.66 Q = 1457.35 m^3/sec	**2**	**4**
	(iv) **Ans.**	**Derive the relation between Duty, delta and Base period.** Let D = Duty in Ha / cumec Δ = Delta in meters B = Base period in days 1) If we take a field of area D Ha, water supplied to field corres-ponding to water depth of Δ meters = Δ X D X 10^4 cubic meter = Δ X D X 10^4 m^3 ----------------(1)	**1**	
		2) Again for same field of D Ha, one cumec of water is required to flow during the entire base period. Hence, water supplied to this field = 1 X B X 24 X 60 X 60 m^3 --------(2) Equating, (1) and (2)	**1**	
		Δ X D X 10^4 = 1 X B X 24 X 60 X 60 Δ = (B X 86400) / (D X 10^4) Δ = (8.64) B / D	**1**	
		or D = (8.64) B / Δ	**1**	**4**

The table under "Classification based on Administration":

Sr. No.	Class of project	Command Area (ha)
1	Major project	Over 10000
2	Medium project	10000 - 2000
3	Minor Project	Less than 2000

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	**b)**	**Attempt any ONE of the following :**		**6**
	(i)	**In an area four rain gauge station which are equidistant from each other at a distance of 6 km. The rainfall measured at each station is 4 cm, 2.8 cm, 6 cm and 8 cm. Calculate average rainfall.**		
	Ans.	Total numbers of rain gauge stations are 4 $$\therefore N = 4$$	1	
		Find out $\sum P$ i.e. sum of rainfall for all stations. $$= (4+2.8+6+8)$$	1	
		$$\therefore \sum P = 20.8 \text{ mm}$$	1	
		$\therefore$ Rainfall $=$ Average Rainfall	1	
		$$P = \frac{\sum P}{N}$$	1	
		$$= \frac{20.8}{4}$$ $$= 5.2 \text{cm}$$	1	6
		(Note: If any other appropriate method used should be considered.)		

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502
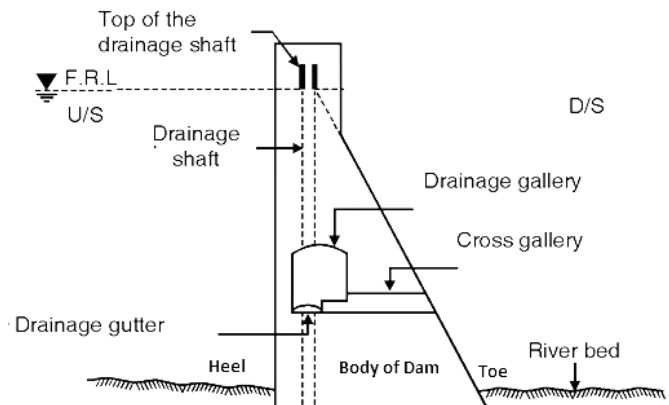
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	**b)** **(ii)**	**Fix the control levels DSL, FRL, HFL and TBL from following data.** **1) Effective storage required 3000 Ha.m.** **2) Carry over allowances and tank losses 25 %.** **3) Dead storage 10 % of gross storage.**		

Contour RL (m)	580	582	584	610	612	614
Storage (Mm^3)	3.0	4.5	6.0	30	40	50

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
	Ans.	**Assume flood lift as 1.5 m free board as 2.5 m.** Effective storage required for crops = 3000 ha-m = 30 Mm^3 Gross storage = Dead storage + Live storage Live storage = Effective crop water requirement + (Tank losses + Carry over allowance) Effective storage required for crops = 3000 ha-m = (30 Mm^3) Live storage = 30 + (25/100) (30) = 30+7.5 = 37.5 Mm^3 Live storage = 37.5 Mm^3	1	
		Gross storage =10/100 of gross storage + 37.5 0.9 Gross storage = 37.5 Gross storage = 41.66 Mm^3	1	
		From capacity table, by interpolating R.L. corresponding to the capacity 41.66 Mm^3 will be, FRL = 612 + [(614 – 612) / (50 – 40)] X (41.66 – 40) FRL = 612.332 m	1	
		Assuming flood lift = 1.5 m and free board = 2.5 m HFL = FRL + Flood lift HFL = 612.332+ 1.5 HFL = 613.832 m	1	
		TBL = HFL + Free board TBL = 613.832 + 2.5 TBL = 616.332 m	1	
		Dead storage = 10/100 of gross storage $\qquad$ = 10/100 X 41.66 = 4.166 Mm^3 RL corresponding to the capacity of 4.166 Mm^3 DSL = 580 + [(582 – 580) / (4.5 – 3)] X (4.166 – 3) DSL = 581.55m	1	6

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2		**Attempt any <u>FOUR</u> of the following:**		16
	a) Ans.	**Define rate of silting and enlist any three factors affecting silting of reservoir.**		
		Rate of silting:	1	
		The amount of collection of silt into the reservoir is known as rate silting of reservoir.		
		Factors affecting rate of silting:	1 each (any three)	4
		1.Catchment area		
		2.Slope of country		
		3.Beginning of storing water in reservoir		
		4.Nature of surface soil		
		5.Rainfall characteristics		
	b) Ans.	**State the types of survey required for irrigation project and data required for irrigation project.**		
		Survey for irrigation project:		
		1.Reconnaissance survey: In reconnaissance survey following information is collected. The size of catchment area, vegetation in the catchment area, soil type, slopes, existing ponds etc		
		2. Preliminary survey: It is divided as follows into three.		
		a. Engineering surveys		
		1. Water spread.		
		2. Capacity of the reservoir.		
		3. Suitable dam site.		
		4. Site for waste weir and outlets.		
		b. Hydrological survey	2	
		1. To study runoff pattern and to estimate yield.		
		2. To determine maximum discharge.		
		3. Determination of hydrograph of worst flood to determine spillway capacity and its capacity.		
		c. Geological survey		
		1. Water tightness of the basin.		
		2. Stability of foundation for the dam.		
		3. Faulty structure in the basin.		
		4. Type and depth of overburden.		
		5. Ground water condition of region.		
		6. Location of quarry sites for construction materials.		
		3. Detailed survey: After the preliminary survey only a few sites are selected for further consideration. In this type of survey office studies and estimates for each of the selected site is prepared.		

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019
Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	b)	**Data to be collected for Irrigation project:** 1. Size of catchment (area in Km^2) 2. Area under cultivation, under forest and under habitation 3. Type of soil 4. Existing ponds and size , their capacities 5. River sites in that area. 6. Flood levels if available from past record if any 7. Slope of hills 8. Contour survey of reservoir basin 9. Gauging of rivers 10. Availability of materials of construction 11. Sedimentation problem 12. Trial pits and boring at dam site 13. Soil survey for commanded area 14. Details of land being submerged and rehabilitation problems	2	4
	c) Ans.	**Differentiate between earthen dam and gravity dam. (four points)**	1 each	4

Sr. N0.	Earthen Dam	Gravity Dam
1	They can be founded on any soil.	They cannot be found on any soil without any proper foundation.
2	There is more seepage through the body of dam and its foundation compared to gravity dam.	Comparatively there is less seepage in case of gravity dam.
3	**a.** For its construction skilled labours are not required. **b.** Construction cost of earthen dam is less. **c.** For the earth dams the diversion of flow during construction is costly.	**a.** For its construction skilled labours are required. **b.** Construction cost of gravity dam is more. **c.** The diversion of flow during construction of gravity dam is costly.
4	Maintenance of earthen dam is more.	Maintenance of gravity dam is less.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	d) Ans.	**Draw the neat sketch of gravity dam with usual notation.** **Fig. Gravity Dam** *(Note: 2 marks for sketch and 2 marks for notation)*	4	4
	e) Ans.	**Explain any two types of failure of earthen dam and give their remedial measures.** **1. Hydraulic failures:** About 40% of earthen dam failures due to this reason only. It includes overtopping of dam surface, failure of u/s slope due to wave erosion, toe erosion, gullying etc. These failures can be avoided by taking following remedial measures. a) Design capacity of spillway accurately. b) Provide sufficient free board. c) Stone pitching and wave breakers on upstream face.		
		2. Seepage failures: More than 33% of earthen dam failures due to seepage. Seepage always occurs in earthen dam. It does not harm its stability, if it is within design limit. It includes piping, sloughing. These failures can be avoided by taking following remedial measures. 1) Proper compaction and bonding between layers. 2) Careful Investigations of foundation soil. 3) Proper design.	1	
		Remedial measures to avoid failure of earthen dam: **1) Control of seepage through embankment** a) Provide Hearting in the central portion of dam. b) Provide casing over the hearting. c) Provision of horizontal drainage blanket **2) Control of seepage through foundation** a) Provide cutoff trench under hearting zone. b) Provide concrete cut-off wall. **3) Control of seepage in general** a) Provide rock toe on d/s face at toe. b) Provide pitching on u/s slope. c) Provide turfing on d/s slope. d) Provide berms at 8 to 10 m vertical interval on downstream.	1	

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	e)	**Structural Failure :** 1. Slide in embankment. 2. Foundation slide. 3. Failure due to earth quake. 4. Failure due to holes caused by burrowing animals. 5. Failure by spreading. 6. Failure due to leaching of water soluble salts.	1	
		Remedial measures to avoid structural failure: 1. Care should be taken that excessive pore pressure should not be formed during construction of dam. 2. Avoid sudden draw down of reservoir. 3. Avoid steep slopes, regular maintenance of slope. 4. Earthquake pressure should be considered while designing dam.	1	4
	f) Ans.	**Explain energy dissipation spillway with and without gates.** **Spillway:** It is an arrangement provided at the crest of dam to expel the excess water rises above the full reservoir level. This is necessary otherwise water will go on rising even above HFL and will start flowing from top of dam which may affect stability of dam. Therefore it is very essential to provides spillway to dispose surplus water on downstream side. **Energy dissipation:** When water flows from crest and if the difference in upstream and downstream water level is more. This causes very high velocity. This high velocity has a very high kinetic energy which can scour the bed. Hence, energy dissipaters help in reducing this kinetic energy of flow.	2	
		Energy Dissipation spillway types: **1. Spillway with gate (controlled):** It has mechanical structures or gates to regulate the rate of flow. This design allows nearly the full height of the dam to be used for water storage year around and flood waters can be released as required by opening one or more gates. **2. Spillway without gate (uncontrolled):** It does not have gates, when the water rises above the lip or crest of the spillway it begins to be released from the reservoir. The rate of discharge is controlled only by the depth of water above the reservoir spillway. Storage volume in the reservoir above the spillway crest can only be used for the temporary storage of flood water it cannot be used as water supply storage because it is normally empty.	2	4

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502
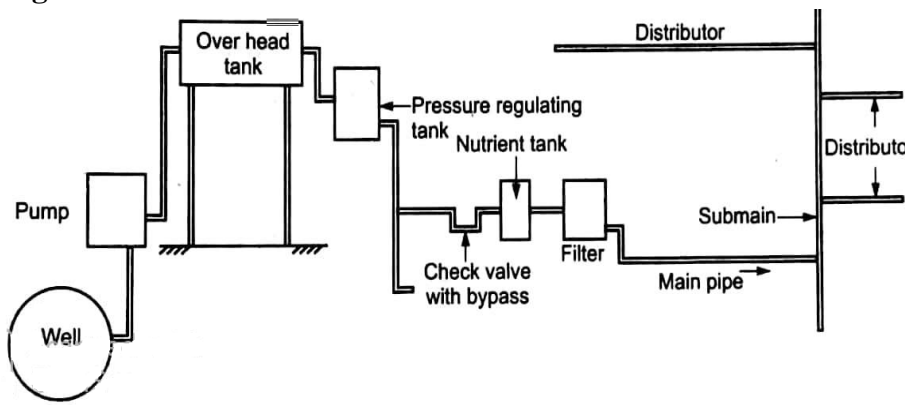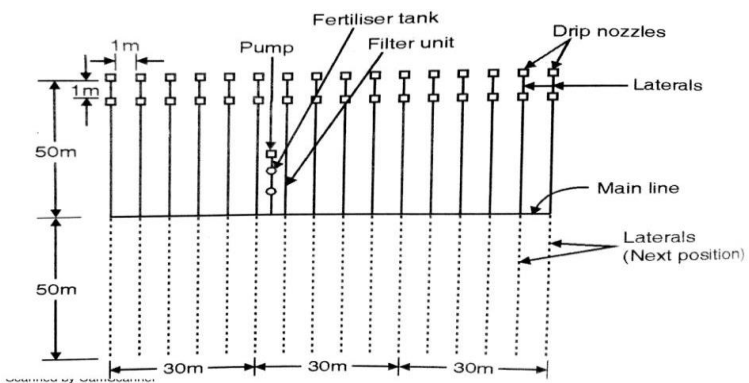
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	a)	**Attempt any <u>FOUR</u> of the following:** **Differentiate between ogee spillway and bar type spillway.**		16
	Ans.		1 each	4

Sr. No.	Ogee Spillway	Bar Type Spillway
1.	The profile of the spillway is ogee or 's' shaped.	The profile is simple vertical fall type.
2.	It is mostly used for gravity dam.	It is mostly used for M.I. tanks or percolation tanks.
3.	It is constructed in concrete and mostly used for large height gravity dams.	It is low height spillway founded on concrete block resting on hard rock foundation.
4.	The falling water is made to glide over the curved profile of the spillway.	The water fall straight and near the bottom of spillway.

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
	b) Ans.	**Explain theoretical and practical profile of gravity dam.** **Theoretical Profile:** It is an elementary profile and only two important forces i.e. water pressure and the weight of the dam is considered. It is right angled triangle. It is an economical profile because material of dam is stressed to its maximum safe compressive stress.	2	
		Practical Profile: In this profile practical requirements i.e. free board and top width is considered. All types of forces acting on the dam are considered. Road way at top is possible. It is not right angled but some modifications are made.	2	4

	c)
	Ans.
		Give the salient feature of vertical gate with their use.
		Following are the salient features of vertical gate with their use
		  i) Gate groove: Steel plate move through these grooves
		  ii) Lifting cable: To lift the gate
		  iii) Steel plate : To work as gate and stop water
		  iv) M.S.R.S.J.: To support steel plate
		  v) Rolling wheels: For easy movement of gates
		  vi) Guide Rail: To guide the rolling wheels
			1 each (any four)	4

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 3	d) Ans.	**State any four criteria for selection of site for percolation tank.** The important points considered for selection site for percolation tank: 1. The tank bed should be pervious. 2. The nalla or stream should have sufficient discharge in monsoon. 3. There should be number of wells on downstream side of the tank. 4. A good agricultural land should be available near each well. 5. The flanks on both the sides of the nalla should be rising with steep slopes. 6. The materials of construction, labour, machinery, approach road should available nearby.	1 each (any four)	4
	e) Ans.	**Give the construction and working of bandhara irrigation.** A bandhara is a masonry diversion weir of small height, 1.2m to 4.5m. constructed across a nallah or a small stream. The water level is raised and it is diverted to a small canal taking off from the upstream side of bandhara. Following are the main component parts of bandhara. i. The bandhara ii. Screen wall iii. The flood banks iv. Off taking canal. The bandhara is constructed in masonry and has trapezoidal shape. Screen wall is kept 0.3m above the H.F.L. so that flood water is controlled. Flood embankment is provided from the upstream end of screen wall to confine the flood water in the stream. Water obstructed by the bandhara is diverted to off taking canal from upstream side.	2 2	4

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502
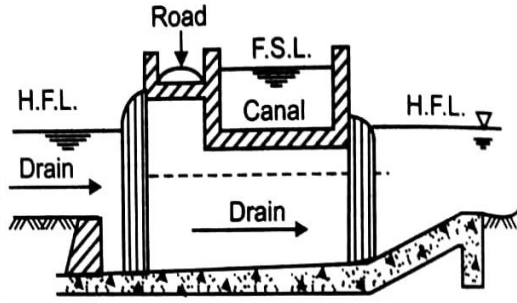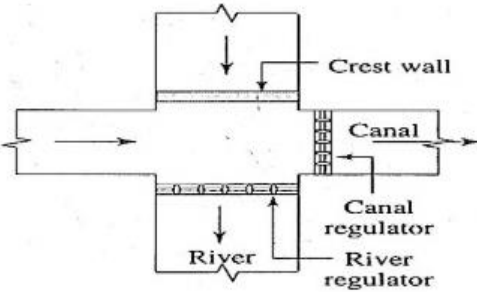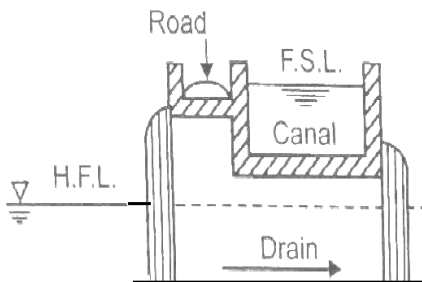
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	a)	**Attempt any <u>THREE</u> of the following:**		12
	(i)	**State two advantages and two disadvantages of bandhara irrigation.**		
	Ans.	**Advantages of bandhara irrigation:** a. The system of irrigation is economical b. Maximum utilization of water. c. The length of canal and distribution system is small, hence water losses are very less. d. The area to be irrigated is close to the source, hence duty and intensity of irrigation is high. e. Ease in construction	1 each (any two)	
		Disadvantages of bandhara irrigation: a. The irrigation area of one bandhara is more or less fixed. b. The system of water becomes seasonal and unreliable in summer if river is non-perennial. c. If number of bandhara's are constructed on a stream downstream people may be adversely affected.	1 each (any two)	4
	(ii)	**Draw layout of lift irrigation and give their component.**		
	Ans.	 **Fig. Layout of Lift Irrigation Scheme**	2	
		Component Parts: 1) Intake well 2) Inlet chamber 3) Jack well 4) Inlet pipe 5) Engine House 6) Rising main 7) Delivery chamber 8) Water distribution system	2	4

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	a) (iii) Ans.	**State the component of weir with their functions.** Following are the components of weir with their function. a. Body of weir- To raise the water level on the upstream side. b. Upstream apron- It protects the main body of the weir during floods. c. Upstream curtain wall- To reduce the uplift pressure. d. Downstream apron- To protect the downstream bed of the river. e. Downstream curtain wall- To protect downstream and floor from uplift pressure f. Crest- To resist the water pressure during floods. g. Shutter- To raise water level on upstream side and divert it in to the canal for irrigation purpose.	1 each (any four)	4
	(iv) Ans.	**Define barrage and enlist the function of their component part.** **Barrage:** If storage of water is done by gates and very small portion or nil portion of water is stored by raised crest then the barrier is called as barrage.	1	

		Function of component parts:
		a. Gate:
		   1. To maintain Water level.
		   2. To raise the water level during low supplies and also flood control.
		b. Inverted Filter:
		   1. Check the escape of fine soil particles in the seepage water.
		c. Scouring Sluices:
		   1. Control silt entry into channel.
		   2. Pass the low floods without dropping.
		d. Divide Wall:
		   1. To keep the cross-section, if any, away from the canal.
		   2. To serve as a trap for coarser bed material.
		   3. To serve as a side-wall of the fish ladder.
		   4. To separate canal head regulator from main weir.
		e. Fish Ladder:
		   1. For the movement of fish.
		f. Sheet Piles:
		   1. Protect barrage structure from scour.
		   2. Reduce uplift pressure on barrage.
		g. Marginal Bunds:
		   1. Provided on the upstream in order to protect the area from submergence due to rise in HFL, caused by afflux.
		h. Groans or Spurs:
		   1. Protect the bank from which they are extended by deflecting the current away from the bank.
			3	4

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	b) (i) Ans.	**Attempt any <u>ONE</u> of the following:** **Draw the layout of drip irrigation and write the maintenance of drip irrigation.** **OR** **Fig. Layout of Drip Irrigation** **Maintenance of drip irrigation:** 1. Filters should be checked daily and clean it if required. 2. At the end of cropping season, filters should be cleaned with acid to remove clogging. 3. If bacteria and algae are grown on pipe line, then emitters can be plugged worse. 4. Check drippers periodically for to avoid clogging. 5. Filter screens should be flushed and cleaned once in a month in accordance with water quality 6. Drip tubes should be flushed periodically. 7. Flush the lines once in a year by removing end caps. 8. Once in week, observe the drip irrigation system and check water is flowing from each dripper. If dripper is not working, replace it.	2 1 each (any four)	6 6

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	**(ii)**	**Calculate the balancing depth for a channel section having a bed width equal to 18m and side slope of 1:1 in cutting and 2:1 in filling. The bank embankments are kept 3.0m higher than the ground level and crest width of bank is kept as 2.0m.**		
	Ans.	Fig. Channel Section	1	

Let , d_c = economical depth of cutting

Height of embankment above G.L = 3.0 m

Area of cutting $= (b + nd)$

$\qquad = (18 + 1 \times d_c)d_c$

$\qquad = 18\, d_c + d_c^2$ ....equation 1

Area of cutting = 2(area of one bank)

$\qquad = 2[(b + nd)d]$

$\qquad = 2[(b + 2h)h]$

$\qquad = 2[(2 + 2 \times 3)3]$

$\qquad = 2[(2 + 2 \times 3)3]$

$\qquad = 48$ ....equation 2

Equating area of cutting = area of filling

For economical or balancing depth

$18\, d_c + d_c^2 = 48$

$d_c^2 + 18\, d_c - 48 = 0$

$d_c = \dfrac{-18 \pm \sqrt{18^2 - 4 \times (-48)}}{2 \times 1}$

$d_c = 2.355 m$

Marks
1
1
1
1
1
1

Total Marks: **6**

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019
Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5	a)	**Attempt any <u>TWO</u> of the following:** **A main canal irrigates the following crops:**		16
	Ans.			

Name of crop	Base period (Days)	Area under crop (Ha)	Duty (Ha/cumec)
Cotton	200	2500	1300
Wheat	120	7000	2000
Rice (Kharif)	120	3050	900
Sugarcane	360	4600	800
Vegetables (Hw)	120	1400	500

Designs the capacity of canal consider canal losses as 10% and capacity factor 0.85.

Given,

Canal losses = 10% = (100-10)/ 100 = 0.90

Capacity factor = 0.85

1. **Cotton:**

$$\Delta = \frac{8.64B}{D} = \frac{8.64 \times 200}{1300} = 1.329$$

$$V_{cotton} = A \times \Delta = 2500 \times 1.329 = 3323.07 Ha.m$$

2. **Wheat:**

$$\Delta = \frac{8.64B}{D} = \frac{8.64 \times 120}{2000} = 0.518$$

$$V_{wheat} = A \times \Delta = 7000 \times 0.518 = 3628.8 Ha.m$$

3. **Rice:**

$$\Delta = \frac{8.64B}{D} = \frac{8.64 \times 120}{900} = 1.152$$

$$V_{rice} = A \times \Delta = 3050 \times 1.152 = 3513.6 Ha.m$$

4. **Sugarcane:**

$$\Delta = \frac{8.64B}{D} = \frac{8.64 \times 360}{800} = 3.888$$

$$V_{sugarcane} = A \times \Delta = 4600 \times 3.888 = 17884.8 Ha.m$$

5. **Vegetables:**

$$\Delta = \frac{8.64B}{D} = \frac{8.64 \times 120}{500} = 2.0736$$

$$V_{sugarcane} = A \times \Delta = 1400 \times 2.0736 = 2903.04 Ha.m$$

Total Volume of water = 3323.07+3628.8+3513.6+17884.8+2903.04

= 31253.31

Canal Capacity = $\dfrac{\text{Total Volume of water}}{0.90 \times 0.85} = \dfrac{31253.31}{0.90 \times 0.85} = 40854$Ha-m

Marks column (right side, aligned to steps): 1, 1, 1, 1, 1, 1, 2

Total Marks: 8

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019
Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5	b)	**State the procedure of maintenance and repair of radial and vertical gate.**		
	Ans.	**Maintenance and repair of radial and vertical gate :**		
		1. Monthly maintenance:		
		• Seals and seal seating shall be inspected for leakages. Locations of excessive leakages shall be recorded for taking remedial measures.		
		• Excessive or wide spread leakages if any shall be reported to Engineer–in–charge and remedial measures like tightening of bolts is to be carried out necessary plan for replacement of parts shall be initiated and carried out before floods.		
		• Remove all dirt, girt, etc., from trunnion assembly and lubricate trunnion bearings of the gate with suitable water resisting grease.	2	
		• More concentration is to be given for checking of welds : (i) Between yoke girder web and tie flats. (ii) Between trunnion and tie between turnnion. (iii) Lifting bracket and gate.		
		2. Quarterly Maintenance:		
		• The maintenance shall preferably be carried out once in three months including pre- monsoon and post monsoon maintenance.		
		• All the nuts and bolts of trunnion assembly and its anchorages shall be checked for tightness.		
		• Check all the welds for soundness and rectify defects if any.		
		• Check welding between latching bracket and skin plate with help of magnifying glass for cracks / defects and rectify the defects.		
		• Clean all drain holes including those in end arms, horizontal girders trunnion and pulley blocks.		
		• Check all nuts and bolts for tightness and tighten them if loose.	3	
		• Check upstream face of skin plate for pitting, sealing and corrosion. Sealing formation shall be removed, pitting shall be filled with weld and ground, and Corroded surface shall be cleaned and painted. In case of gate not being raised every quarter, these can be carried out in annual maintenance.		
		• The wheel bearings and guide rollers shall be lubricated.		
		• The seal shall be checked for damages, if damaged, shall be replaced.		
		• All nuts and bolts shall be tightened.		
		• The guide assemblies, wheel assemblies and sealing assemblies shall be cleared of girt, sand or any other foreign material.		
		• General cleaning is to be done for the following: Hoist bridge components, trunnion girders / yoke girders, trunnion brackets, trunnions arms and horizontal girders.		

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)** **Ans.**	• Lubrication is to be attended for: Bearings at Gate wheels, trunnion bushes, hoist pulleys and pins provide in Hoist Bridge at hoist level and gate. Rope drum shaft Plummer blocks. Line shaft Plummer blocks. • Check tightness of all coupling bolts of motor to work reducer and line shaft. If required they may be tightened. • Care shall be taken to check the condition of holding rope with rope socket and balancing of gate is to be observed and if necessary adjusted. **3. Annual maintenance:** • The following additional checks or maintenance shall be carried out in addition to checks mentioned under quarterly maintenance. • All the embedded parts shall be checked for defects / damages and shall be rectified where ever noticed and exposed parts shall be painted for longer life. • The sill beam and guides shall be cleared for all girt, sand etc., • The wire ropes shall be checked for equal tension. If broken strands are noticed, the wire rope shall be replaced. Fixing of rope sockets also shall be checked. • The wire rope shall be greased. • The guide roller pins shall be lubricated and ensure for its rotation. • Check the condition of rubber seal. If damaged, replace the seals. • All bolts and nuts holding rubber seals shall be tightened. Adjust seal if leakages are found at local points.	3	8

	c)	**Suggest the suitable type of CD work and draw sketch of it under each of the following situation.**
		  (i) **Nala bed level is above FSL of canal.**
		  (ii) **HFL of nala is between FSL of canal and bed level of Canal.**
		  (iii) **Canal bed level and nala Bed level are same**
		  (iv) **Canal bed level is above HFL of nala**		

	Ans.	**(i) Nala bed level is above FSL of canal:** **Fig. Super passage**	2	

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: **Irrigation Engineering**

Sub. Code: **17502**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5.	**c)** **Ans.**	**HFL of nala is in between FSL of canal and bed level of Canal:** **Fig. Syphon Aqueduct** **(ii) Canal bed level and nala Bed level are same:** **Fig. Level Crossing** **(iii) Canal bed level is above HFL of nala:** **Fig. Aqueduct**	**2** **2** **2**	**8**

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6	**a)** **Ans.**	**Attempt any FOUR of the following:** **Draw a neat sketch of diversion head work, show component parts of it and write the function of each.** **Fig. Diversion Head Work** **Function of component of diversion head work:** **i) Head regulator:** 1) It regulates the supply of water entering in canal. 2) It controls the entry of silt into canal. 3) It prevents the river flood entering the canal. **ii) Divide wall:** 1) To separate flow from the scouring weir which is at lower level than proper weir 2) To separate the silting packet from scouring sluices 3) To prevent formation of cross currents to avoid domain effects 4) To cut off the main portion of the river and provide a comparatively quite packet in front of the canal head regulator resulting in deposition of silt in the pocket and enter clear water in canal **iii) Fish ladder:** 1) To help the survival of the fishes 2) To provide free movement of fishes **iv) Scouring Sluice:** Deposited silt and soil are scoured through the scouring sluice **v) Stilling Pond:** 1) To reduce velocity of water. 2) To settle down the silt & allow clear water to the canal.	**2** **2**	**16** **4**

Subject: Irrigation Engineering

Que. No.	Sub. Que.	Model Answer	Mark	Total Marks
Q.6	b)	**Differentiate between weir and barrage with respect to.** **(i) Flood control** **(ii) Afflux** **(iii) Maintenance** **(iv) Crest level**		
	Ans.		**1 each**	**4**
	c)	**Classify the canal according to alignment and position in the canal network.**		
	Ans.	**Classification based on alignment:** 1) Contour Canal 2) Ridge Canal 3) Side Slope Canal **Classification based on position:** 1) Main Canal 2) Branch Canal 3) Major Distributary 4) Minor distributary 5) Water Course 6) Head Work	**2** **2**	**4**

Table (under Q.6 b):

Sr. No.	Points	Weir	Barrage
i	**Flood Control**	Control over the flood is not possible.	Good control over the flood situation.
ii	**Afflux**	It gives high afflux	It gives low afflux
iii	**Maintenance**	Maintenance of barrage is difficult.	Maintenance of weir is easy.
iv	**Crest Level**	Crest level is below HFL. In some cases it is at FSL.	Crest level is at river bed level.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)
Model Answer: Winter-2019

Subject: Irrigation Engineering

Sub. Code: 17502

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6	**d)**	**Explain the design procedure for most economical canal section.**		
	Ans.	**Design procedure for most economical canal section:**		
		A channel which gives maximum discharge for a given cross sectional area and bed slope is called a channel of most economical cross–section.		
		1. For design of canal section, discharge, coefficient of rugosity, canal side slopes and longitudinal bed slope should be known.		
		2. For most economical channel.		
		Half of the top width = Length of the slopping side	1	
		$R = \dfrac{d}{2}$ $\qquad \dfrac{b + 2nd}{2} = d\sqrt{n^2 + 1}$		
		Calculate b in terms of d.	1	
		3. Calculate area		
		Area = (b + nd)d		
		4. Use Manning's formula or Chezy's Formula to calculate Velocity		
		$v = \dfrac{1}{N} \times R^{\frac{2}{3}} \times S^{\frac{1}{2}}$	1	
		OR		
		$v = C\sqrt{R \times S}$		
		5. Calculate discharge Q = A x V to find dimensions of b and d.	1	**4**
	e)	**Explain water logging and state three causes of water logging.**		
	Ans.	**Water logging:** The condition of soil when it becomes completely saturated with water and becomes unfit for the growth of plants is called as water logging.	1	
		Causes of Waterlogging:		
		1. Over and Intensive irrigation		
		2. Seepage of water from the adjoining high lands		
		3. Seepage of water through canals	1 each (any three)	**4**
		4. Impervious Obstruction		
		5. Inadequate natural drainage		
		6. Inadequate surface drainage		
		7. Excessive rainfall		
		8. Submergence due to floods		